

REMARKS/ARGUMENTS

Overview of the invention: Unwanted thermal expansion of the main pole of a magnetic write head is prevented by thermally connecting the write coil to the substrate. This is done through a thermally conductive pedestal that extends upwards from the substrate and is in turn connected to the coil through a thermally conductive layer

Reconsideration is requested of all rejections based on objections to the abstract:

A new abstract that conforms to the guidelines provided by examiner has been provided.

Reconsideration is requested of all rejections based on objections to the specification:

Examiner's explanation that his statement that there is "no antecedent basis in the specification for the microstructure as recited in the claims" is a standard form is understood but, regrettably, does not clarify the substance of the statement itself.

As examiner knows, antecedent basis need not always be the exact word or phrase for which it is serving as an antecedent (MPEP 2173.05(e) **Lack of Antecedent Basis [R-5]**). In particular, a claim is indefinite when it contains words or phrases whose meaning is unclear. We do not believe this to be the case here since dimensions for this structure, quoted in several places, are all in microns, which makes it clear to anyone skilled in the art that this is a micro-structure. We have, however, changed "micro-structure" to --structure--, as required by examiner.

Regarding our arguments that demonstrate that a key part of the Jensen invention is inoperable, it appears that copies of the abstracts that we cited as part of our argument did not reach examiner. We apologize for this and provide them herewith. They will be discussed further below.

In addition to the various elements that relate to a magnetic write head, the present invention claims two novel features (not taught by Jensen) whose purpose is to cool the write coil. The latter is referred to in the specification as element 17 and can be seen in FIGs. 3-7. The first novel feature is the thermally conductive pedestal that is referenced as element 23 and can be seen in FIGs. 2-5. The second novel feature is thin film 41 that provides a high thermal conductance path between the coil and the pedestal and can be seen in FIGs. 4 and 5.

Claim 1 now reads as follows (element numbering added):

1. A method to dissipate heat generated by a coil (17) located within a structure, that is on a substrate, (10) comprising:
forming a thermally conductive pedestal (23) that originates at said substrate and extends upwards therefrom; and
forming a layer of thermally conductive material (41) that thermally connects said coil to said substrate through said pedestal, thereby providing an unbroken thermal path between said coil and said substrate.

Similarly for claim 25.

As can be seen in FIG. 5, the structure is then planarized until top magnetic pole 21 is just exposed, thereby forming heat diffuser 41 that, together with thermally conductive pedestal 23, provides an unbroken thermal path between the write coil(s) and the undercoat/substrate. Also, in FIG. 7, via hole 73 is overfilled with thermally conductive material and the structure is planarized until top magnetic pole 21 is just exposed. As in the first embodiment, the completed structure features heat diffuser 41 that, together with the filled via hole, provides a thermal path between the write coil(s) and the undercoat.

Note the high thermal conductance path between the coil and the substrate.

Without it, heat from the coil would have to pass through several low thermal conductance layers, particularly layer 19. See later discussion below.

Reconsideration is requested of the rejection of claims 1, 3, 4, 25, 27, and 28 under 35 U.S.C. 102(b) as being anticipated by Jensen et al.

Jensen attempts to solve the coil overheating problem, in part, by underlying the coil with deposited layer 532 that is asserted to be both a good electrical insulator and a good thermal conductor. The preferred materials for this layer are stated to be aluminum nitride or silicon nitride whose thermal conductivities **when in bulk form** approach the values cited by Jensen. In the bulk material this relatively high thermal conductivity is due only to lattice conduction (by phonons). Were it otherwise they could not be good electrical insulators. However, when deposited as thin films, good lattice conduction is no longer possible because such films are polycrystalline so the phonons get scattered at the grain boundaries. Even if the films were monocrystalline, phonon reflection and absorption at the film's surfaces would reduce their thermal conductivity. This argument is based on physical principles that are well known to anyone skilled in this art.

Additionally, there is no teaching by Jensen of how the heat absorbed by layer 532 is to be removed from the vicinity of the coil. As can be seen in Jensen's figure 5, this absorbed heat must pass through lower pole 512, dielectric layer 508, and lower shield 510 before reaching substrate 506. The two "pedestals" 522 and 524, cited by examiner extend only as far as layer 518. Unlike the present invention, there is no unbroken thermal path (commonly referred to by those skilled in the art as a thermal short circuit) to convey heat directly to the substrate as is disclosed and (now) claimed in the present invention.

Note that the unbroken thermal path to which we refer is shown in our FIG. 5 as element 41 which, together with element 23, connects coil 20 to substrate 10. It can also be seen in our FIG. 7 where element 41, together with element 73, connects coil 20 to substrate 10.

Jensen's invention does not include a sub-structure, similar to our unbroken thermal path, to perform a similar function. We respectfully request that examiner demonstrate the contrary or allow our claims 1 and 25.

Reconsideration is requested of the rejection of claims 2, 5, 6, 26, and 29 under 35 U.S.C. 103(a) as being unpatentable over Jensen et al.

Regarding claims 2 and 26, examiner argues that it would have been obvious for one skilled in the art to select an insulating material having a thermal conductivity in the range recited in claims 2 and 26. With the greatest respect we had requested that examiner provide us with but a single example of a material that, in thin film form, has been reported to be both a good electrical insulator and to have a thermal conductivity in the range 100 to 400 W/m⁻¹K⁻¹.

Examiner has not responded to this request but has, instead, required us to produce objective evidence to the effect that NO deposited film has EVER been reported to be both a good electrical insulator and to have a thermal conductivity in the range 100 to 400 W/m⁻¹K⁻¹. As examiner surely knows, it is impossible to prove a negative since we would need, in principle, to survey ALL films ever deposited. On the other hand, since examiner contends that it would be obvious to use such a film, we must assume that examiner believes that such films exist and examiner should therefore have no difficulty providing a SINGLE example of such a film, as we had requested.

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Reply to Office action of 08/26/2008

As already noted, we have attached copies of statements from four authoritative sources in compliance with examiner's requirement of objective evidence. These are:

Reference 1 (Sun Rock Choi et al.) confirms that the thermal conductivity of thin films is significantly less than the corresponding bulk material.

Reference 2 (Jungho Mun et al.) shows that the thermal conductivity of as-deposited titania films is in the range of $0.7\text{--}1.7\text{ Wm}^{-1}\text{K}^{-1}$; bulk value is $11.7\text{ Wm}^{-1}\text{K}^{-1}$.

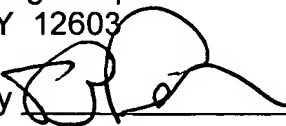
Reference 3 (Jansen and Obermeier) gives a value of $4\text{ Wcm}^{-1}\text{K}^{-1}$ for a diamond film. This is a very low value compared to bulk diamond which is recognized as having a greater thermal conductivity than any other electrically insulating material.

Reference 4 (Wikipedia article on Properties of Diamond) confirms that the bulk thermal conductivity of diamond exceeds $30\text{ Wcm}^{-1}\text{K}^{-1}$.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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